DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

ERASMUS+ COURSE CATALOGUE AND MODULES DESCRIPTION

SEMESTER	CODE	MODULE	ECTS	LECTURER(S)	E-MAIL(S)
1	EEE.1.1	Mathematical Analysis I	5	Papadopoulos P	ppapadop@uniwa.gr
1	EEE.1.3	Electrical Circuits I	7	Vassiliadis S	svas@uniwa.gr
1	EEE.1.7	Introduction to Programming	4	Angeli Ch Metafas D Valamontes E	angeli@uniwa.gr dmetafas@uniwa.gr vala@uniwa.gr
2	EEE.2.1	Mathematical Analysis II	5	Papadopoulos P	ppapadop@uniwa.gr
2	EEE.2.3	Electrical Circuits II	6	Vassiliadis S	svas@uniwa.gr
2	EEE.2.4	Logic Design	5	Tsakiridis O	odytsak@uniwa.gr
2	EEE.2.5	Object oriented Programming	4	Angeli Ch Patrikakis Ch Feidakis M	angeli@uniwa.gr bpatr@uniwa.gr m.feidakis@uniwa.gr
2	EEE.2.6	Numerical Analysis	3	Famelis I	ifamelis@uniwa.gr
3	EEE.3.1	Differential Equations-Transforms (Laplace, Fourier, Z)	5	Papadopoulos P	ppapadop@uniwa.gr
4	EEE.4.2	Computer Systems Architecture	6	Goustouridis D Kaltsas G Rangoussi M	dgousto@uniwa.gr gkaltsas@uniwa.gr mariar@uniwa.gr

4	EEE.4.4	Probability Theory and Statistics	5	Famelis I	ifamelis@uniwa.gr
4	EEE.4.8	Energy and Environment	3	Psomopoulos C	cpsomop@uniwa.gr
5	EEE.5.8	English for Specific Purposes I	3	Tsatsaros P	pt@uniwa.gr
6	EEE.6.4	Computer Networks	6	Patrikakis Ch Tatlas N	bpatr@uniwa.gr ntatlas@uniwa.gr
6	EEE.6.8	English for Specific Purposes II	3	Tsatsaros P	pt@uniwa.gr
7	EEE.7-1.2	Electric Machines I	6	Karaisas P	karaisas@uniwa.gr
7	EEE.7-1.3	High Voltage Engineering	5	Psomopoulos C	cpsomop@uniwa.gr
7	EEE.7-2.4	Electroacoustics I	5	Potirakis S	spoti@uniwa.gr
7	EEE.7-3.1	Microcontrollers-Embedded Systems	5	Kaltsas G	gkaltsas@uniwa.gr
8	EEE.8-1.5	Electric Machines II	6	Karaisas P	karaisas@uniwa.gr
8	EEE.8-1.7	Building Energy Analysis	3.5	Moronis A	amoronis@uniwa.gr
8	EEE.8-2.1	Optical Communications	5	Stathopoulos N	nstath@uniwa.gr
8	EEE.8-2.3 / EEE.8-3.7	Internet of Things	3	Koulouras G	gregkoul@uniwa.gr
8	EEE.8-2.7	Broadband Communications	5	Karabetsos S	sotoskar@uniwa.gr
8	EEE.8-3.6	Embedded Systems Programming	5	Metafas D	dmetafas@uniwa.gr
9	EEE.9-1.3	Lighting Technology	6	Ioannidis G	gioan@uniwa.gr
9	EEE.9-2.8	Radar and Remote Sensing	5	Mitilineos S. A.	smitil@uniwa.gr

9	EEE.9-2.10	Design of Telecommunication Systems	5	Karabetsos S	sotoskar@uniwa.gr

➔ **For a description of each module please refer to the following pages**

SCHOOL	SCHOOL OF ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING		
LEVEL OF STUDIES	*Undergraduate*		
COURSE CODE	EEE.1.1	**SEMESTER**	1
COURSE TITLE	MATHEMATICAL ANALYSIS I		
ECTS	5		
PREREQUISITE COURSES:	-		
IS THE COURSE OFFERED TO ERASMUS STUDENTS:	Yes (in English)		

MODULE DESCRIPTION

The 1st Semester of Mathematical Analysis extends and combines the students' existing knowledge on the calculation of functions of one variable with the applications. Also, provides them the tools to effectively address and solve suitable scientific problems.
On the other hand it includes new fields such as complex numbers, series, dynamics in vector analysis, plane vector functions, differential equations, etc, which are essential in engineering mathematical courses. Mathematical Analysis I, aims in the advancement of mathematical literacy and analytical mathematical thinking of the student as any Mathematic course and lesson must do.
Upon successful completion of this course module students possess advanced knowledge, skills and competences in the subject of Mathematics that enable them to:

- Work with the field of complex numbers, representing them in trigonometric and exponential form and calculating roots and powers of complex numbers
- Able to find - examine convergence, continuity and calculate limits for functions, sequences and series.
- Able to recognize known curves of the plane.
- Know how to apply the derivatives to its various applications and develop functions in Taylor series.
- Study the basic integration techniques.
- Understand the physical point of view for the derivates and for the integrals and how to use them in order to solve engineering and mechanics problems.
- Apply taught methods to calculate integrals (indefinite, definite and generalized integrals).
- Apply taught methodology in problem solving of other fields of science and technology, in real life contexts.
- Use vector analysis and its basic operations (inner product, angle, external product, etc) in analyzing problems and synthesizing solutions.
- Assess different methods for the synthesis of solutions to real-life problems and select the appropriate for the problem at hand.
- Study first order ordinary differential equations, for example Differential Equations of Separated Variable and able to study their applications in many fields of science and engineering.

SCHOOL	SCHOOL OF ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING		
LEVEL OF STUDIES	*Undergraduate*		
COURSE CODE	EEE.1.3	**SEMESTER**	1
COURSE TITLE	ELECTRICAL CIRCUITS I		
ECTS	7		
PREREQUISITE COURSES:	-		
IS THE COURSE OFFERED TO ERASMUS STUDENTS:	Yes (in English)		

MODULE DESCRIPTION

Theory

Introduction to the DC electric circuits.
Electric components, voltage and current sources.
Basic laws of the electric circuits.
Circuits' analysis: Mesh-current method.
Circuits' analysis: Node-voltage method.
Superposition theorem and applications.
Thevenin and Norton theorems and applications.
Load matching and maximum power transfer theorem
Millman theorem and applications.
Transient response of 1st order linear circuits, time constant.

Laboratory

Introduction, safety regulations, Fundamental Laws (Ohm and Kirchoff), Circuit Theorems (Thevenin, Norton, maximum power transfer), transient response of 1st order linear circuits.

SCHOOL	SCHOOL OF ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING		
LEVEL OF STUDIES	*Undergraduate*		
COURSE CODE	EEE.1.7	**SEMESTER**	1
COURSE TITLE	INTRODUCTION TO PROGRAMMING		
ECTS	4		
PREREQUISITE COURSES:	-		
IS THE COURSE OFFERED TO ERASMUS STUDENTS:	Yes (in English)		

MODULE DESCRIPTION

1: Introduction to Computer Programming
Basic Concepts of procedural programming, Programming Languages, Introduction to the C programming language.
2: Code Development
Development of the first program using the C programming language. Basic characteristics, basic syntax.
3: Data types and Variables
Data types and Variables, Constants, Operators, Assignments statements.
4: Calculations
Calculations, Input/ Output, basic operations**.**
5. Decision Statements
Comparisons and decisions, logical operators, Nested comparison statements.
6: Loops
Repetition statements, nested loops.
7. Arrays
One-dimensional Arrays, Multi-dimensional Arrays.
8: Pointers
Pointers, Arrays and Pointers, Memory management.
9: Using Strings
Using of Strings, String Functions, Strings and Pointers.
10. Functions
Using Functions, Function Types, Variable Scope, User defined Functions, Pointers and Functions.
11: Structures
Using of Structures, Pointers and Structures, Arrays and Structures, Structures and Functions, Unions, Bit-Fields.
12: Files
Files handling, Types of Files, File Operations, Text Files, Binary Files
13: Algorithms
Basic Algorithms presentation.

SCHOOL	SCHOOL OF ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING		
LEVEL OF STUDIES	*Undergraduate*		
COURSE CODE	EEE.2.1	**SEMESTER**	2
COURSE TITLE	MATHEMATICAL ANALYSIS II		
ECTS	5		
PREREQUISITE COURSES:	EEE.1.1 - MATHEMATICAL ANALYSIS I		
IS THE COURSE OFFERED TO ERASMUS STUDENTS:	Yes (in English)		

MODULE DESCRIPTION

Mathematical Analysis II of the second semester refers to the multivariate analysis (partial derivation and its applications, multiple integrals) and the vector functions in the space (derivative, integration, line integrals, surface integrals, etc.), in order the student to address basic concepts (e.g. gradient, curl, fields, optimization, total differential, etc.). New concepts are introduced for the student, such as surface integrals, Cauchy-Riemann Equations, line integrals etc. Finally, students will know, through an introductory approach, the calculus of complex series, complex functions and also their integration. Like every mathematical course and lesson, also Mathematical Analysis II, is the promotion of mathematical literacy and the analytical mathematical thinking of the student.

Upon successful completion of this course module students possess advanced knowledge, skills and competences in the subject of Mathematics that enable them to:

- Know and be able to apply the Laplace Operator and Hamilton Operator to compute gradient, deviation, rotation, etc for various types of functions.
- Solve basic problems in Vector analysis.
- Know the difference between vector and scalar functions.
- Perform analysis of functions of many variables, compute limits, continuity, derivative, etc.
- Decide whether a given function is harmonic or not.
- Decide whether a vector field is conservative.
- Apply taught methods to compute extreme points (maxima and minima) of functions of two or more variables.
- Calculate the line integrals of the first and of the second type.
- Calculate surface integrals.
- Able to implement multiple or double integration in applications.
- Learn both the mathematical and the physical dimensions of the concepts associated with Gauss, Green and Stokes theorems.
- Able to handle basic topics, like calculating complex functions, complex sequences and integrating complex functions, too.
- Select the appropriate method for the solution of a given problem. Do this for problems coming from various fields of science and technology.

SCHOOL	SCHOOL OF ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING		
LEVEL OF STUDIES	*Undergraduate*		
COURSE CODE	EEE.2.3	**SEMESTER**	2
COURSE TITLE	ELECTRICAL CIRCUITS II		
ECTS	6		
PREREQUISITE COURSES:	EEE.1.3 – ELECTRICAL CIRCUITS I		
IS THE COURSE OFFERED TO ERASMUS STUDENTS:	Yes (in English)		

MODULE DESCRIPTION

Theory

AC Voltage and current. Average and Effective value.
Introduction to the AC electric circuits.
Impedance, simple circuits.
Complex numbers, phasors.
Circuits' analysis: Mesh-current method.
Circuits' analysis: Node-voltage method.
Power: Active, reactive, complex and apparent
Power factor
Superposition theorem and applications.
Thevenin and Norton theorems and applications.
Load matching and maximum power transfer theorem
Magnetically coupled circuits, Transformers.
Multiphase systems, Introduction to electrical machines

Laboratory

Introduction, safety regulations, AC measurements, impedance measurements, resonators, coupled circuits, transformers.

SCHOOL	SCHOOL OF ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING		
LEVEL OF STUDIES	*Undergraduate*		
COURSE CODE	EEE.2.4	**SEMESTER**	2
COURSE TITLE	LOGIC DESIGN		
ECTS	5		
PREREQUISITE COURSES:	-		
IS THE COURSE OFFERED TO ERASMUS STUDENTS:	Yes (in English)		

MODULE DESCRIPTION

- **Number Systems**. To work with a positional number systems and numeric representations
- **Boolean algebra** To introduce basic postulates of and show the correlation between Boolean expression.
- **Combinational Logic**. Students will be able to analyze and do some simple design of combinational logic. They will be familiar with and incorporate into circuits the basic gates, decoders, encoders, multiplexers, demultipexers, adders and subtractors.
- **Sequential Logic.** Students will be able to analyze and do some simple design of sequential logic. They will be familiar with and incorporate into circuits the latches, flip-flops, and counters.
- **Synchronous & Asynchronous circuits**. To design and implement synchronous and asynchronous sequential circuits.

SCHOOL	SCHOOL OF ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING		
LEVEL OF STUDIES	*Undergraduate*		
COURSE CODE	EEE.2.5	**SEMESTER**	2
COURSE TITLE	OBJECT-ORIENTED PROGRAMMING		
ECTS	4		
PREREQUISITE COURSES:	EEE.1.7 - INTRODUCTION TO PROGRAMMING		
IS THE COURSE OFFERED TO ERASMUS STUDENTS:	Yes (in English)		

MODULE DESCRIPTION

1: Introduction to the Object Oriented Programming
Basic Concepts of the object oriented programming.
2: Code Development
Development of the first program using the Java programming language. Basic characteristics, basic syntax.
3: Variables
Data types and Variables, Constants, Operators, Assignments statements and Calculations.
4: Methods, Classes and objects
Classes and Objects, Inheritance, Encapsulation, Polymorphism.
5: Decision Statements
Comparisons and decisions, operators, Nested comparison statements.
6: Loops
Repetition statements.
7. Arrays
One-dimensional Arrays, Multi-dimensional Arrays, Array Lists.
8: Graphical User Interface
Classes and Interfaces. Graphical User Interface Programming, Applications development.
9: Using Platforms
Platforms for applications development.
10: Files, Programmer-Defined Types
Direct Access Files and Object Classes.
11: Web Applications
Web applications development.
12: Object oriented languages
Other languages for the object oriented paradigm such as JavaScript and Visual Basic. Presentation and comparisons.
13: Introduction to development environments
Introduction to development environments.

SCHOOL	SCHOOL OF ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING		
LEVEL OF STUDIES	*Undergraduate*		
COURSE CODE	EEE.2.6	**SEMESTER**	2
COURSE TITLE	NUMERICAL ANALYSIS		
ECTS	3		
PREREQUISITE COURSES:	-		
IS THE COURSE OFFERED TO ERASMUS STUDENTS:	Yes (in English)		

MODULE DESCRIPTION

This course aims at introducing students to the fundamental concepts of Numerical Analysis that is essential to an electrical and electronic engineer. The course provides the knowledge to numerically solve basic mathematical problems that emerge in engineering applications.
On successful completion of this course students will be able to:

- understand the concept of calculation errors and its accumulation in approximate solutions.
- apply iterative methods to solve non-linear equations, having understood the concept of convergence of these methods.
- learn to apply direct or iterative methods for the solution of linear systems of equations and perceive the importance of these methods in engineering science applications.
- understand how derivatives are approximated and he/she will know how to calculate numerically integrals.
- comprehend the concept of numerical solution of differential equations.

Having acquired this knowledge base, the student will be able to use effectively and modify numerical problem-solving algorithms implemented in a popular programming environment such as Matlab.

Course Outline:

Part 1 "Introduction to Numerical Analysis, Errors and Approximation"
Part 2 "Approximate Roots of Non Linear Equations"
Part 3 "Numerical Linear Algebra"
Part 4 "Approximation of functions"
Part 5 "Numerical Differentiation and Integration"
Part 6 "Numerical solution of differential equations"

SCHOOL	SCHOOL OF ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING		
LEVEL OF STUDIES	*Undergraduate*		
COURSE CODE	EEE.3.1	**SEMESTER**	3
COURSE TITLE	DIFFERENTIAL EQUATIONS AND TRANSFORMS		
ECTS	5		
PREREQUISITE COURSES:	-		
IS THE COURSE OFFERED TO ERASMUS STUDENTS:	Yes (in English)		

MODULE DESCRIPTION

Differential Equations-Transforms of the third semester refers to differential equations (ordinary and partial) for topics such as: types of differential equations, solution of differential equations (first and higher order), elements of qualitative and analytical theory, systems of differential equations, etc. On the other hand new concepts are introduced for the student, such as Laplace transformation, Fourier series and transformations (for circuit solving, for using in Automatic Control Systems, for waveform analysis, etc.) and Z transformation.

Finally, students will be introduced to the theory of Partial Differential Equations (PDE) through an introductory approach. PDEs are one of the most important areas of both theoretical and applied mathematics. This fact is due, on the one hand, to the frequent use of PDEs in physics, technology, biology, economy and into other applied sciences, and, on the other hand, to the plethora of new problems, questions and theorems that are created and developed in the field of theoretical mathematics. Like every mathematical course and lesson, also Differential Equations-Transforms, is the promotion of mathematical literacy and the analytical mathematical thinking of the student.

Upon successful completion of this course module students possess advanced knowledge, skills and competences in the subject of Mathematics that enable them to:

- Able to recognize the type of differential equations, categorize and solve them.
- Study first order ordinary differential equations, second and higher order homogeneous and non-homogeneous differential equations with stable coefficients.
- Able to apply their applications in many fields of science and engineering.
- Apply the Laplace Transformation to solve differential equations and also to apply it to differential equations that model electric circuits.
- Know and be able to explain in writing the nature, role and basic laws of Laplace transform and of frequency domain.
- Know to develop the Fourier series of periodic function and plan their frequency spectrum.
- Be familiar with the use of Fourier Transformation in Systems and with the concept of transportation functions.
- Apply Z transformation and its inverse to solve difference equations.
- Study Partial Differential Equation and their Applications.
- Select the appropriate method for the solution of a given problem. Do this for problems coming from various fields of science and technology.

SCHOOL	SCHOOL OF ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING		
LEVEL OF STUDIES	*Undergraduate*		
COURSE CODE	EEE.4.2	**SEMESTER**	4
COURSE TITLE	COMPUTER SYSTEMS ARCHITECTURE		
ECTS	6		
PREREQUISITE COURSES:	-		
IS THE COURSE OFFERED TO ERASMUS STUDENTS:	Yes (in English)		

MODULE DESCRIPTION

- Background – History
- Introduction to the Architecture of Computer Systems
- Arithmetic Issues (Number systems, numerical representations, etc.)
- Systems Organization – Computer Architecture
- Memory organization and operation - Addressing
- Central Processing Unit Architectures
- Basic functions of the Central Processing Unit
- Techniques to increase the efficiency of the Central Processing Unit
- Programming in machine language
- Interrupt System
- Data I/O Techniques
- Communications systems
- Parallel architectures
- Distributed system architectures
- Evolutionary trends (ANN, Fuzzy, Dataflow, Quant)

SCHOOL	SCHOOL OF ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING		
LEVEL OF STUDIES	*Undergraduate*		
COURSE CODE	EEE.4.4	**SEMESTER**	4
COURSE TITLE	PROBABILITY THEORY AND STATISTICS		
ECTS	5		
PREREQUISITE COURSES:	-		
IS THE COURSE OFFERED TO ERASMUS STUDENTS:	Yes (in English)		

MODULE DESCRIPTION

This course aims at introducing students to the fundamental concepts of Probability Theory and Statistics, culminating multidimensional random variables and inferential statistics. The course also introduces basic ideas of modeling using Markov processes and techniques of proof that are of vital importance in future courses in electrical and electronic engineering.
On successful completion of this course students will be able to:

- calculate probabilities of stochastic events
- understand the appropriate cognitive tools that are necessary for the development of statistical inference
- solve problems that are modeled using random variables and draw conclusions on their results
- understand the concept of the correlation and independence of random variables
- comprehend the significance of the limit theorems in Probability Theory and the concept of convergence of random variables
- model physical phenomena using Markov Chains and draw conclusions upon their analysis.

The students are introduced into the basic ideas of inferential statistics, and learn methodologies with which they can generalize the conclusions they get for the sample to the population by using various estimators and interpreting their basic properties. They will also know, from the point of view of Statistics, the very important concepts of Linear Correlation and Linear Regression. The problems the students deal with in this course are related to the electrical and electronic engineering studies subject and to more general engineering applications and therefore the students will be equipped with all the required knowledge to cope with other courses.

Course Outline:
Part 1 "Introduction to Probability Theory"
Part 2 "Random Variables and Probability distributions"
Part 3 "Special Topics of Probability Theory"
Part 4 "Introduction to Descriptive and Inferential Statistics"
Part 5 "Linear regression."

SCHOOL	SCHOOL OF ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING		
LEVEL OF STUDIES	*Undergraduate*		
COURSE CODE	EEE.4.8	**SEMESTER**	4
COURSE TITLE	ENERGY AND ENVIRONMENT		
ECTS	3		
PREREQUISITE COURSES:	-		
IS THE COURSE OFFERED TO ERASMUS STUDENTS:	Yes (in English)		

MODULE DESCRIPTION

Energy and environmental policies and their interdependence. Energy generation and environment, greenhouse gasses emissions and climate change. Energy efficiency and energy saving: Introduction to energy efficiency in products and systems. The European Directives Eco-label, Energy-label, Eco-design, RoHs, EMAS, and their application to equipment and various industrial devices. The life cycle analysis in the production and operation of the equipment. End-of-life of waste electrical, electronic and industrial equipment. Legislation. Designing systems in accordance with the instructions for EcoDesign.

SCHOOL	SCHOOL OF ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING		
LEVEL OF STUDIES	*Undergraduate*		
COURSE CODE	EEE.5.8	**SEMESTER**	5
COURSE TITLE	ENGLISH FOR SPECIFIC PURPOSES I		
ECTS	3		
PREREQUISITE COURSES:	-		
IS THE COURSE OFFERED TO ERASMUS STUDENTS:	Yes (in English)		

MODULE DESCRIPTION

A course in English through authentic subject-specific texts including diagrams, circuits, tables, graphs and illustrations and with a high density of relevant technical vocabulary. Texts with a variety of comprehension and vocabulary exercises such as open-ended questions, true/false statements, question forming, sentence completion, multiple-choice questions, sentence building, matching, filling-in blanks, word formation, synonyms and opposites, compound words and so on.

Texts adapted from original sources with context-based tasks such as skimming, scanning, matching texts to pictures, information transfer, identifying characteristics, rephrasing, interpreting or describing diagrams, making deductions, describing component characteristics, sequencing ideas, identifying logical relations and so on.

Texts referring to: Electric Energy and Power, Resistance and Resistors / Conductors, Semiconductors, and Insulators / Capacitors and Capacitance, Electromagnetism and Electromagnetic Induction, Direct-current Circuits, Alternating current and Voltage, Energy Systems-Energy storage, Analogue & Digital Systems – Digital Processing, Logic Circuits, Electrical Measurements / Electrical Measuring Equipment, Circuit-protective Equipment – Grounding Systems, Computer Systems – Computer Networks, Electromagnetic Waves –Antennas, Transmitters & Receivers.

SCHOOL	SCHOOL OF ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING		
LEVEL OF STUDIES	*Undergraduate*		
COURSE CODE	EEE.6.4	**SEMESTER**	6
COURSE TITLE	COMPUTER NETWORKS		
ECTS	6		
PREREQUISITE COURSES:	-		
IS THE COURSE OFFERED TO ERASMUS STUDENTS:	Yes (in English)		

MODULE DESCRIPTION

Chapter 1: Introduction

Introduction to computer networks and to the ever-growing reach and use of the Internet, and of 4G/5G networks.

Chapter 2: Application Layer

It covers the application layer, and includes material on the new HTTP/2 and HPPT/3 protocols for the Web.

Chapter 3: Transport Layer

It reflects advances in, and evolution in use of, transport-layer congestion control and error control protocols over the past five years. It provides a deeper coverage of TCP Cubic, the default TCP protocol in many deployed systems, and examine delay-based approaches to congestion control, including the new BBR protocol, which is deployed in Google's backbone network. It also studies the QUIC protocol, which is being incorporated into the HTTP/3 standard.

Chapter 4: Network Data Plane

It covers the network-layer data plane, including a section on so-called "middleboxes," which perform network-layer functions other than routing and forwarding, such as firewalling and load balancing and material on topics such as the amount of buffering that is "just right" in network routers, on net neutrality, and on the architectural principles of the Internet.

Chapter 5: Network Control Plane

It covers the network-layer's control plane, contains updated material on SDN, and a significantly new treatment of network management. The use of SDN has evolved beyond management of packet-forwarding tables to include configuration management of network devices as well.

Chapter 6: Link Layer and LANs

It covers the link layer, reflacting the continuing evolution of link-layer technologies such as Ethernet. It also includes reference to datacenter networks, which are at the heart of the technology driving much of today's Internet commerce.

Chapter 7: Wireless and Mobile Networks

It includes introduction to short-range Bluetooth piconets, medium-range wireless 802.11 local area networks (WLANs), wide-area 4G/5G wireless cellular networks. and coverage of mobility issues, from the local issue of handover of mobile devices between base stations to the global issue of identity management and mobile device roaming among global cellular provider networks.

Chapter 8: Network Security

It covers network security, including wireless network security in particular, WPA3 security in WLANs, and mutual device/network mutual authentication and confidentiality in 4G/5G networks.

Chapter 9: Multimedia Networking

It includes material related to multimedia networking.

SCHOOL	SCHOOL OF ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING		
LEVEL OF STUDIES	*Undergraduate*		
COURSE CODE	EEE.6.8	**SEMESTER**	6
COURSE TITLE	ENGLISH FOR SPECIFIC PURPOSES II		
ECTS	3		
PREREQUISITE COURSES:	EEE.5.8 - ENGLISH FOR SPECIFIC PURPOSES I		
IS THE COURSE OFFERED TO ERASMUS STUDENTS:	Yes (in English)		

MODULE DESCRIPTION

A course in English through authentic subject-specific texts including diagrams, circuits, tables, graphs and illustrations and with a high density of relevant technical vocabulary. Texts with a variety of comprehension and vocabulary exercises such as open-ended questions, true/false statements, question forming, sentence completion, multiple-choice questions, sentence building, matching, filling-in blanks, word formation, synonyms and opposites, compound words and so on.

Texts adapted from original sources with context-based tasks such as skimming, scanning, matching texts to pictures, information transfer, identifying characteristics, rephrasing, interpreting or describing diagrams, making deductions, describing component characteristics, sequencing ideas, identifying logical relations and so on.

Texts referring to: DC Machines / AC Machines / Transformers, Power generation, Renewable Energy Sources, Power Control, Power Transmission and Distribution, Control Systems, Illumination, Telecommunications, Power Electronics, Optical Communications, Object-oriented Programming, Mechatronics, Robotics.

SCHOOL	SCHOOL OF ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING		
LEVEL OF STUDIES	*Undergraduate*		
COURSE CODE	EEE.7-1.2	**SEMESTER**	7
COURSE TITLE	ELECTRIC MACHINES I		
ECTS	6		
PREREQUISITE COURSES:	-		
IS THE COURSE OFFERED TO ERASMUS STUDENTS:	Yes (in English)		

MODULE DESCRIPTION

- Understand the basic concepts of magnetic circuits as applied to electric machines.
- Understand the basic operation of a transformer.
- Understand terminal markings and various single phase and three phase wiring schemes.
- Understand the electrical testing methods performed on transformers such as insulation resistance testing, excitation and power factor testing.
- Describe the critical parts of transformer specifications
- Describe various transformer types and different methods of construction, application, and their advantages and disadvantages
- Explain transformer protection fundamentals
- Understand three phase transformers and different types of three phase circuits and connections.
- Understand basic motors and generators.
- Describe the operation of DC machines
- Explain construction and operation principle of dc motors and dc generators
- Describe the working principle of a DC motor and a DC generator.
- Describe the operation of, and factors affecting output and direction of current flow in DC generators.
- Describe the operation of, and factors affecting output power, torque, speed and direction of rotation of DC motors.
- Describe the difference between motors and state the use of series wound, shunt wound and compound DC motors.
- Explain construction and operation principle of transformers
- Describe methods of speed control and direction of rotation.

SCHOOL	SCHOOL OF ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING		
LEVEL OF STUDIES	*Undergraduate*		
COURSE CODE	EEE.7-1.3	**SEMESTER**	7
COURSE TITLE	HIGH VOLTAGE ENGINEERING		
ECTS	5		
PREREQUISITE COURSES:	-		
IS THE COURSE OFFERED TO ERASMUS STUDENTS:	Yes (in English)		

MODULE DESCRIPTION

1st Part: Introduction to high voltage engineering: Basic concepts and definitions, high voltage applications, high electric fields, different forms of electric fields, electrodes' geometries and basic knowledge.

2nd Part: Air gaps breakdown theory: Basic gaseous dielectrics. Properties of air gaps, the physics and the phenomena which appear during their use in high voltage equipment and structures. Ionization and breakdown phenomena in air gaps under uniform and non-uniform high electric fields. Townsend's breakdown theory. Corona effect in electric networks and Corona losses. Streamers and ladders theory on gaseous dielectrics.

3rd Part: SF6 and gaseous mixtures breakdown theory: SF6 physicochemical properties and its behavior under uniform and non-uniform electric fields. Ionization and breakdown phenomena in SF6 gaps under uniform and non-uniform high electric fields. Other gaseous mixtures in high voltage engineering. Phenomena during their use in high voltage equipment and structures.

4rd Part: Liquid dielectric materials: Basic liquid dielectric materials, mineral and natural dielectric oils and their physicochemical properties. Aging and breakdown mechanisms in dielectric oils under uniform and non-uniform electric field stress. Effects during their use in high voltage equipment and structures.

5th Part: Generation and measurement of in high voltage testing: Typical waveforms of high voltages used for equipment testing. AC high voltage testing equipment. DC high voltage circuits (rectifiers, Cocroft, Villard, Greinacher topologies) and testing equipment. Impulse voltage and current testing equipment. Single and multiple stages generators. High voltage measuring equipment selection and design. High Voltage dividers. Schering bridge and dielectric losses measurement. High voltage testing and measuring procedures.

6th Part: Solid dielectric materials: Basic concepts and definitions, basic solid dielectric materials and their properties. Loss Factor (tgδ). Specific Electrical Conductivity. Surface Conductivity. Coefficient of Thermal Conductivity. Mechanical strength. Partial Discharges, starting field / voltage, calculation of charge transportation and its waveform during PDs . Experimental Determination of PD. Measuring capacitor Cm. Macroscopic and Quantum Mechanics related theories during aging and breakdown of solid dielectrics. **N**ew theories for the analysis of phenomena, occurring during the operation of high voltage equipment, innovative new materials that will be used in high voltage equipment, etc.

SCHOOL	SCHOOL OF ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING		
LEVEL OF STUDIES	*Undergraduate*		
COURSE CODE	EEE.7-2.4	**SEMESTER**	7
COURSE TITLE	ELECTROACOUSTICS I		
ECTS	5		
PREREQUISITE COURSES:	-		
IS THE COURSE OFFERED TO ERASMUS STUDENTS:	Yes (in English)		

MODULE DESCRIPTION

The course is organized in four sections:
Section 1: Sound applications, electronic-electroacoustic (audio) systems, the effect of space. Parts of an audio system depending on the application, categories of audio systems. The audio system as a linear and time-invariant system, linear distortions. Non-linear distortions and system noise.
Section 2: Sound waves, wave equations, speed of sound, traveling and standing waves. Sound sources, source directivity, sound intensity as a function of source power and distance from it. Sound measurement, level and frequency, noise measurement. Outdoor sound propagation, reflection-refraction-propagation / absorption.
Module 3: Equivalent circuits of mechanical and acoustical systems. Electro-mechano-acoustical systems, electroacoustic converters (sensors & actuators). Basic types of microphones, operating principles, basic relationships, features. Use of microphones. Basic types of speaker drivers, operating principles. Electrodynamic speaker driver analysis, equivalent circuits, Thiele-Small parameters. Loudspeakers, crossover circuits. Measurement of the loudspeaker enclosure-speaker driver system, determination of design parameters.
Module 4: Audio system subsystems, types and characteristics: connectors, wiring, preamplifiers (topologies, specifications), mixers, power amplifiers (power supply and output stages, classes, circuits), digital power amplifiers, power amplifier operating characteristics (power, harmonic distortion, input / output characteristics), dynamic range processors, signal processors, sound recording systems, electrical audio signal sources, loudspeakers and linear loudspeaker arrays, distributed systems.

Within the course, practical exercises and demonstration of the process of applied acoustic / electroacoustic measurements such as sound level measurement, microphone calibration, impulse response acquisition of electroacoustic system will be performed.

SCHOOL	SCHOOL OF ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING		
LEVEL OF STUDIES	*Undergraduate*		
COURSE CODE	EEE.7-3.1	**SEMESTER**	7
COURSE TITLE	MICROCONTROLLERS – EMBEDDED SYSTEMS		
ECTS	5		
PREREQUISITE COURSES:	-		
IS THE COURSE OFFERED TO ERASMUS STUDENTS:	Yes (in English)		

MODULE DESCRIPTION

Introduction to Embedded Systems – Basic Concepts

Generic computer – Embedded System; Hardware/software co-design; Basic Features of Embedded Systems; Embedded Systems Applications; Basic Parts of Embedded Systems; Embedded systems as Cyber-Physical Systems; Limitations on Embedded Systems Applications; Design and Operation Parameters

The Microcontroller as an Embedded System Platform

Basic concepts and principles of operation – Functional diagrams; Control, Data and Address buses; Memory systems; Microcontrollers' architecture (von Neuman – Harvard); Instruction set (CISC, RISC, VLIW); Pipelining; Programing model (Accumulator Based - General Purpose Registers); Basic microcontrollers' interface circuits

AVR microcontrollers' families

Features of 8-bit AVR microcontrollers; Memory types (data memory: SRAM - EEPROM, program memory: FLASH); Introduction to AVR instruction set (Op-Code, commands' execution time); AVR Assembly Program outline; Introduction to interrupt vectors; Programming in assembly for AVR; Peripherals of AVR microcontrollers; Timing circuits; Parallel I/O ports

Software Architecture for Embedded Systems

Data Input/Output; Operators; Loops; Bits Management; Logical operators by binary digit; Binary digit control; Shift operators by binary digit; Binary digit fields; Peripheral devices I/O commands

Programming microcontrollers in higher-level language

General Program Outline; Data Types; Functions; Variables – Constants; Bit Variables; Casting; Pointers; EEPROM access ; Structures; Definitions – Macros; Incorporation of Symbolic Language Programs; I/O Registers Access; I/O Registers Access at Bit Level; Library Functions; Integration of LCD and 7 Segment displays; Serial communication; Communication through I2C protocol; Communication through SPI protocol; Use of LCD; ADC– Control, use and Applications; Real-time programming – External Interrupts; Use of timer/counters, DC Motors; Connection and control of graphical LCD screens; Use of Pulse Wave Modulation

SCHOOL	SCHOOL OF ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING		
LEVEL OF STUDIES	*Graduate*		
COURSE CODE	EEE.8-1.5	**SEMESTER**	8
COURSE TITLE	ELECTRIC MACHINES II		
ECTS	6		
PREREQUISITE COURSES:	EEE.7-1.2 ELECTRIC MACHINES I		
IS THE COURSE OFFERED TO ERASMUS STUDENTS:	Yes (in English)		

MODULE DESCRIPTION

- Key parts of AC electrical machines, Categories of AC rotating machines, Windings of electrical machines. Operation in all four quadrants. Rotating magnetic field. Development of tension and torque.
- Asynchronous three-phase motor. Operating Principle. Equivalent single-phase circuit. Flow of power and degree of Performance
- Asynchronous three-phase motor. State equations. Torque-speed curve. Simplified Formula of Kloss. Maximum output power.
- Asynchronous three-phase motor. Identifying parameters of the equivalent circuit. Separation of mechanical losses and core losses.
- Asynchronous three-phase motor. Normalized curves. Effect of varying the voltage power to the torque-speed curve.
- Asynchronous three-phase motor. Effect of Varying frequency to the torque- speed curve. Time of acceleration. Asynchronous three-phase double cage motor.
- Asynchronous three-phase motor. Start Methods. Methods of braking asynchronous three-phase motors. Operation of three-phase motor as a single phase one.
- Asynchronous single-phase motor. Theory of two rotating fields. Equivalent circuit. Torque - Power. Calculation of equivalent circuit constants
- Asynchronous single-phase motor. Start Methods of single phase motors. Shaded pole motors.
- Synchronous generator construction. The equivalent circuit of a Synchronous generator. Power and Torque in Synchronous generator. Measuring Synchronous generator model parameters. Parallel operation of AC generators.
- Synchronous motor. Basic principles of motor operation. Steady-state Synchronous motor operation. Starting Synchronous motors.

SCHOOL	SCHOOL OF ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING		
LEVEL OF STUDIES	*Graduate*		
COURSE CODE	EEE.8-1.7	**SEMESTER**	8
COURSE TITLE	BUILDING ENERGY ANALYSIS		
ECTS	4		
PREREQUISITE COURSES:	-		
IS THE COURSE OFFERED TO ERASMUS STUDENTS:	Yes (in English)		

MODULE DESCRIPTION

- General information on the energy performance of buildings.
- Embodied energy, operation energy and equivalent greenhouse gas emissions.
- Requirements of European legislation for energy efficient buildings and for energy certification and labeling. International standards for the determination of the energy performance of buildings.
- Design conditions and parameters.
- Behavior of opaque and transparent building elements.
- Static and dynamic models for energy calculations. Data-driven energy analysis models. The quasi-stable state physical model.
- Determination of thermal zones.
- Parameters and calculations for the assessment of energy exchanges between indoor and outdoor environments.
- The influence of the thermal capacity of building elements on their thermal inertia.
- Heat transfer due to infiltration and mechanical ventilation.
- Solar gains. Principles of solar geometry. Assessment of incident solar radiation in horizontal, vertical and inclined structural elements. The effect of different shading types on solar gains.
- Internal heat gains due to human presence, devices and equipment. The energy consumption of electronic and electrical appliances or other devices depending on the type of use of the building.
- Requirements for lighting, lighting loads and natural lighting.
- Heating, cooling and air conditioning loads. Operation of heating, cooling and air conditioning systems. Operation and losses in heating and cooling distribution networks.
- Requirements for hot water systems.
- Renewable energy systems and their contribution to the energy performance of buildings.
- Building automation and control systems.
- Energy efficient interventions in buildings and the evaluation of their effect according to the type of each intervention and the estimated implementation cost.
- Energy measurements in buildings.
- Use of dedicated energy analysis software for energy analysis in buildings.

SCHOOL	SCHOOL OF ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING		
LEVEL OF STUDIES	*Graduate*		
COURSE CODE	EEE.8-2.1	**SEMESTER**	8
COURSE TITLE	OPTICAL COMMUNICATIONS		
ECTS	5		
PREREQUISITE COURSES:	-		
IS THE COURSE OFFERED TO ERASMUS STUDENTS:	Yes (in English)		

MODULE DESCRIPTION

1. Optical spectrum – propagation velocity in optical media – spectral complex refractive index – ray theory and wave optics – Snell's law
2. Optical waveguides – electromagnetic theory and guided modes
3. Guided modes in planar optical waveguides - propagation characteristics, dispersion and absorption.
4. Optical fibers: Weak guidance - linear polarized modes - dispersion relations – fabrication techniques.
5. Propagation characteristics in fibers – single mode and multimode fibers – attenuation – dispersion (intermodal, intramodal, polarizatiion) – graded index fibers – DCF and DSF fibers.
6. Optical sources: semiconductor Lasers – Photodetectors: PIN and APD.
7. Fiber fused biconical taper coupler – modulation techniques – direct and external modulation.
8. Fabry-Perot interferometer filters - MZI chain filters – Optical amplifiers SOA and EDFA.
9. Evaluation of point to point optical link – data rate specifications – bit error rate (BER)
10. Calculation of losses for star topology.
11. Calculation of power budget and dispersion for ring and bus topologies.
12. Wavelength division multiplexing systems WDM - OADM.
13. Fiber optic link measurements – OTDR.

SCHOOL	SCHOOL OF ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING		
LEVEL OF STUDIES	*Graduate*		
COURSE CODE	EEE.8-2.3 / EEE.8-3.7	**SEMESTER**	8
COURSE TITLE	INTERNET OF THINGS		
ECTS	5		
PREREQUISITE COURSES:	-		
IS THE COURSE OFFERED TO ERASMUS STUDENTS:	Yes (in English)		

MODULE DESCRIPTION

The IoT course aims to introduce students to the concept of the Internet of Things and to show them how strongly it affects their everyday life, as well as the ways that it can affect them in the near future. Some of the technologies introduced in the course are cutting edge concepts that will promote innovative thinking.

Course Syllabus:

Section 1: Introductory concepts
Section 2: Sensors and Microcontrollers
Section 3: Communication and Data Protocols
Section 4: Wireless Sensor Networks
Section 5: IoT Environments, Platforms and Application Development Tools
Section 6: Personal Area Networks Technologies
Section 7: Examples of Real IoT Applications
Section 8: Security and Introduction to the Blockchain Algorithm
Section 9: Cooperation and Communication of Devices in Smart Environments
Section 10: Future Trends

SCHOOL	SCHOOL OF ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING		
LEVEL OF STUDIES	*Graduate*		
COURSE CODE	EEE.8-2.7	**SEMESTER**	8
COURSE TITLE	BROADBAND COMMUNICATIONS		
ECTS	5		
PREREQUISITE COURSES:	-		
IS THE COURSE OFFERED TO ERASMUS STUDENTS:	Yes (in English)		

MODULE DESCRIPTION

Part 1 "Modern Modulation Technologies"

• Lecture 1: Introduction, block diagram of a telecommunication system, Overview of digital modulations (M-QAM, M-PSK), implementation using digital signal processing principles
• Lecture 2: Wideband modulation using multiple carriers – OFDM modulation
• Lecture 3: OFDM receiver, Variations of OFDM (DMT, Windowed OFDM, FBMC, GFDM etc.) SC-FDMA modulation
• Lecture 4: Applications and implementation features of the physical layer of current technologies and standards for wireless and wired networks (4G LTE/LTE-A, 5G New radio, IEEE802.11 WLAN, xDSL)

Part 2 "Spread Spectrum telecommunication systems"

• Lecture 5: Spread spectrum system model, Direct Sequence (DS) spread spectrum systems
• Lecture 6: Applications of DS spread spectrum systems
• Lecture 7: Generation of Pseudo-noise (PN) sequences, Frequency hopping (FH) systems
• Lecture 8: Applications of spread spectrum technologies in telecommunication systems (IS-95, 3G-WCDMA, IEEE802.11)

Part 3 "Multiple Antenna Systems"

• Lecture 9: Channel models for multiple antenna systems
• Lecture 10: Transmission, Reception and Detection of symbols in slow-fading frequency non selective channels
• Lecture 11: Capacity of MIMO systems
• Lecture 12: Channel coding for MIMO systems (Bit interleaving, STBC)
• Lecture 13: Applications of MIMO technologies in standardized wireless networks (4G LTE/LTE-A, 5G, IEEE801.11).

SCHOOL	SCHOOL OF ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING		
LEVEL OF STUDIES	*Graduate*		
COURSE CODE	EEE.8-3.6	**SEMESTER**	8
COURSE TITLE	EMBEDDED SYSTEMS PROGRAMMING		
ECTS	5		
PREREQUISITE COURSES:	-		
IS THE COURSE OFFERED TO ERASMUS STUDENTS:	Yes (in English)		

MODULE DESCRIPTION

Introduction to embedded systems
Overview of the fundamentals
Hardware / software co-design
ARM architecture
ARM assembly
ARM exception handling
ARM program initialization
Profiling and code optimization
Memory architectures
Embedded memory mapped I/O and devices
Timers and Serial Communications
Interrupts
Buffering, DMA
RTOS Processes
RTOS Scheduling
RTOS Concurrency
RTOS Synchronization and deadlocks
Real Time Embedded Systems
Task oriented embedded operating systems
Virtual memory

SCHOOL	SCHOOL OF ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING		
LEVEL OF STUDIES	*Graduate*		
COURSE CODE	EEE.9-1.3	**SEMESTER**	9
COURSE TITLE	LIGHTING TECHNOLOGY		
ECTS	6		
PREREQUISITE COURSES:	-		
IS THE COURSE OFFERED TO ERASMUS STUDENTS:	Yes (in English)		

MODULE DESCRIPTION

Light, radiation, basic principles: luminous radiation, energy, power, flow, intensity of radiation, visible spectrum, vision, colorimetry, color systems. Photometry: introduction to photometry, solid angle, luminous flux, point sources, illuminance, light intensity, luminance, photometric laws (law of the inverse square, sinus law, Lambert law, non-point sources), reflection, transfer, absorption. Light sources & luminaries: incandescent lamps, fluorescent lamps, induction lamps, high intensity discharge lamps: metal halide lamps - sodium discahrge lamps, luminaries, distinction, coding. Indoor lighting: introduction to interior lighting, Favie method, zonal cavity method, EN12464-1 based method. Indoor glare: glare curve system, CIE glare restraint system, reduce glare with the unified glare rating system (UGR). Road lighting: introduction to road lighting, road lighting methodologies, road lighting characteristics, road lighting fixtures, average light intensity method or lumen method, luminance method, road lighting categories according to CEN 13201. Outdoor lighting: Light pollution, urban lighting, exterior work areas, techniques for particular applications. Daylighting: daylighting in buildings (analysis indicators), visual comfort, lighting and health, daylighting systems design. Energy saving: Lighting control protocols, light sensors, harvesting daylight and artificial light systems, energy saving, economic issues.

SCHOOL	SCHOOL OF ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING		
LEVEL OF STUDIES	*Graduate*		
COURSE CODE	EEE.9-2.8	**SEMESTER**	9
COURSE TITLE	RADAR AND REMOTE SENSING		
ECTS	5		
PREREQUISITE COURSES:	EEE.8-2.2 - ANTENNAS		
IS THE COURSE OFFERED TO ERASMUS STUDENTS:	Yes (in English)		

MODULE DESCRIPTION

1. Introduction: Radar fundamentals. History of radar. Radar classifications and types. Pulsed power radar.
2. Radar principle of operation: Pulse shaping and target distance measurement Radar range.
3. Radar antennas and target angle. Radar antennas and specifications. Aperture antennas and antenna arrays. Rotation and stabilization infrastructure. Target angle measurement.
4. Radar equation and target radar cross section (RCS): Radar equation. Backscattering and target trace. Target RCS.
5. Simple scattering problems: Scattering from perfect conductive sphere, infinite cylindrical surface, finite plane.
6. Complex scattering problems: Target scattering models. Swerling classification: SW1, SW2, SW3, SW4, SW0/SW5. Signal fading and signal to noise ratio for complex targets. Radar signal simulation.
7. Detection theory and radar: Radar signal detection with noise. Single-pulse target detection probability.
8. Other radar classifications and types: FMCW and coherent phase radar. Search radars, monitoring and tracking radars.
9. Radar receivers: Matched filter receiver. Uncertainty function.
10. Passive radar sensors: Black body radiation. Principle of radiometry, radiometer requirements and specifications.
11. Synthetic aperture radar (SAR): Linear antennas. Synthetic aperture antenna. SAR principle of operation.
12. Modern radar systems: Spatio-temporal signal processing. MIMO and phased-MIMO radar, mmWaves radar.
13. Course review and debriefing.

SCHOOL	SCHOOL OF ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING		
LEVEL OF STUDIES	*Graduate*		
COURSE CODE	EEE.9-2.10	**SEMESTER**	9
COURSE TITLE	DESIGN OF TELECOMMUNICATION SYSTEMS		
ECTS	5		
PREREQUISITE COURSES:	-		
IS THE COURSE OFFERED TO ERASMUS STUDENTS:	Yes (in English)		

MODULE DESCRIPTION

Section 1 (1 lecture) – Introduction: Introduction to the Digital Radio and to the SDR technology. Review and connection with basic Digital Signal Processing.

Section 2 (2 lectures) – Software Defined Radio: SDR transmitter and receiver architectures. Signal representation. Complex signals and spectrum. Quadrature modulation.

Section 3 (2 lectures) – Hardware and Software tools: Hardware and software development tools and platforms and digital implementation of telecommunication subsystems (FPGA-based SDR development boards e.g., ETTUS and ADALM-PLUTO, Matlab/Simulink, GNU Radio, Python, C/C++).

Section 4 (5 lectures) – Design and Implementation: Methodology, applications and implementation examples in modulation and demodulation in analog (AM, DSBsc, SSB) and digital communications (M-PSK, M-QAM).

Section 5 (3 lectures) – Special topics: Channel modelling, figures of merit, synchronization, carrier recovery, symbol time estimation, resampling, special filters, channel estimation and equalization etc.